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SCIENCE NEWS-LETTER

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FRONT DOOR TO THE AIR

Gangway from Mooring Mast to R-101

(See page 362)

Vol. XVI No. 453

England's Second Large Airship Ready To Take Flight

Aeronautics

WITH the completion of the rigid airship, R-100, England now has the two largest airships in the world. Like the R-101, which has been in the air for about two months, the new ship has a capicity of 5,000,000 cubic feet, as compared with the 2,600,000 cubic feet of the Los Angeles and the 3,708,000 cubic feet of the Graf Zeppelin.

The R-100 was constructed for the British Government by the Airship Guarantee Co. at Howden in Yorkshire, and will soon be turned over to the government authorities. It will be flown to the airship station at Cardington, near Bedford, about 50 miles northwest of London from which test flights will be made. At Cardington are two huge hangars, one for the R-101, which was made there, and the other for the new ship, in addition to a mooring mast.

For several months the R-101 has been making test flights, from the Cardington mooring mast, 200 feet high. Our cover picture, taken recently by a member of the Science Service staff, shows the entrance to the R-101, at the top of the mast. A corridor from this opening leads to the passenger's and crew's quarters amidships. In flight, the "gangplank" closes the opening.

The turning over of the R-100 to the Air Ministry will mark the completion of one of the main stages of England's airship program commenced in 1924 to determine the practicability of airships in long distance transport. For the British Empire, with its far-flung dominions, this is a particularly important problem. Besides the construction of two 5,000,000 cubic foot airships, each almost twice the size of any others built up to that time, this program called for careful preliminary experimental flights to India by way of Egypt. Completely equipped airship stations have been established at Karachi, India, and Ismailia, Egypt. Another will soon be completed at St. Hubert, Canada, while the site has been surveyed for one at Groutville, near Durban, South Africa.

According to present plans, both ships will be fully tested on flights of gradually increasing duration, until by next spring they will be ready for their long flights. Probably the R-101 will make the first flight to India, as it is powered with Diesel engines, and supplies of oil will be available. The R-100 uses gasoline engines, and will probably make the first flight to Canada. These experimental flights may be the forerunner of regular commercial service, and the Airship Guarantee Co. has the option of purchasing the R-100 back from the government should such a service be started.

As in the case of the Graf Zeppelin and Los Angeles, the framework of the R-100 is made from duralumin. That of the R-101 is largely of stainless steel, said to be stronger, weight for weight, than duralumin. The R-100 framework is novel in one important respect, however. The girders are so attached that they can easily be removed or replaced. In other airships damage to a girder required that it be completely cut out and a new piece riveted in.

The passenger quarters on the R-100 are even more commodious than on the government-built R-101. They are on two floors. Cabins with four or two berths each provide sleeping space for 100 passengers, with as much room as on a steamship. The dining room seats 50 persons at a time. Two promenade decks provide a clear view of the territory below, while the lower one is equipped for dancing. There is also a separate recreation saloon. The crew and officers are housed on a third floor below those for passengers. A normal crew of 25 is carried. The navigating cabin is entered through the crew's quarters.

Gasoline is carried in tanks within the envelope, which can normally carry fuel for a 5,000 mile flight if necessary. Ordinarily, however, about 30 tons of gasoline will be carried, sufficient to run the ship for 50 hours at a speed of 75 miles per hour, or about 3,750 miles. This would provide for a paying load of 100 passengers, figuring seven to the ton, and ten tons of freight.

In answer to a recent question in the House of Commons, the Under Secretary of State for Air gave some figures on the cost of the new ships. The original estimates of the R-101 had been 527,000 pounds or $2,600,000, but that it was expected that final figures would show this to have been exceeded. The contract price of the R-100 was set at 350,000 pounds, or $1,800,000.

The large airships of the world are:

Airship	*Capacity Cu. Feet*	*Length Feet*	*Diam. Feet*	*Horsepower*
	AMERICAN			
Los Angeles.....	2,600,000	658.4	90' 8"	2000
ZRS-4 and ZRS-5.....	6,500,000	785	132' 9"	4480
	BRITISH			
R-33 and R-34..	1,960,000	640	78.75	1250
R-38	2,724,000	694.5	85.50	2100
R-100	5,000,000	709	131.00	3900
R-101	5,000,000	732.3	131' 8"	2925
	GERMAN			
Graf Zeppelin....	3,708,000	776	100	2650
LZ-128	5,500,000	.....	.....	5000

The ZRS-4 and the LZ-128 are under construction, and the ZRS-5 is under contract.

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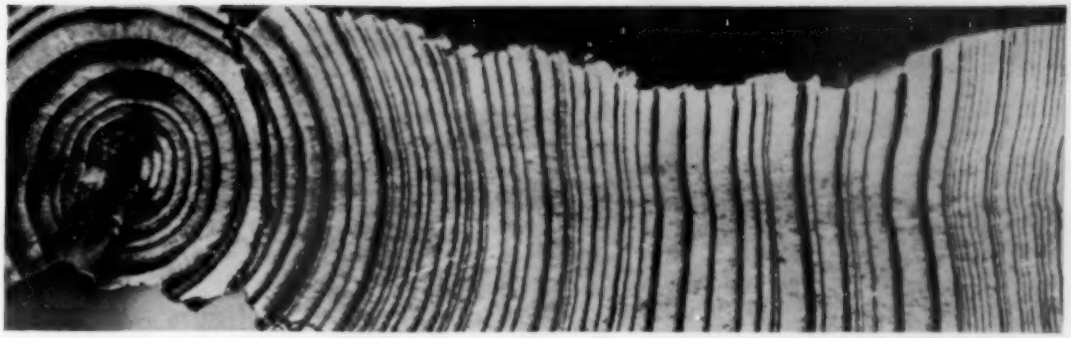


The fir log that was the missing link between Pueblo Bonito timbers and living trees. Born 1073; felled A. D. 1260.

Copyright The National Geographic Society

Tree Rings Date Ancient Ruins

Archæology

THE mysterious, abandoned settlements of the old Southwest have at last been dated by fragments of beam and timber that have survived in the ruins. Pueblo Bonito, apartment house metropolis in New Mexico, had building programs in the years 919, 1017, 1033-92, 1102, and 1130. The Cliff Palace of the Mesa Verde ruins, in Colorado, was constructed with wood cut in the year 1073. The White House Pueblo bears the date 1275. Some forty other ruins have similarly been dated.

Thus the efforts of Dr. A. E. Douglass, astronomer of the University of Arizona, and archæologists cooperating with the National Geographic Society, have led to a collection of more than 5,000 cross-sections of living trees and timbers from the prehistoric Indian ruins, and by reading the annual climatic record set by the trees in their rings, Dr. Douglass has finally succeeded in carrying his wooden calendar back to the Golden Age of the Pueblos.

"We have pushed back the horizons of history in the United States for nearly eight centuries before Columbus reached the shores of the New World," Dr. Douglass stated, "and we have established in our Southwest a chronology for that period more accurate than if human hands had written down the major events as they occurred."

Dr. Douglass pointed out that just as the Rosetta Stone provided the key to the written mysteries of ancient Egypt, so the collection of an unbroken series of tree rings has made clear the chronology of the Southwest.

"These researches have carried the calendar back to A. D. 700 in the Southwest, and they have provided the beginnings of a continuous weather chart for 1,200 years," he continued.

"Through this work we have learned of some outstanding events in America which were contemporaneous with the conquest of Spain by the Moors, and we know that certain Pueblo Indian settlements were enjoying their golden ages when William the Conqueror faced Harold the Saxon at the Battle of Hastings.

"The earliest beam we recovered from Pueblo Bonito was cut A. D. 919 from a tree that was 219 years old when cut. Pueblo Bonito had reached its golden age in 1067 and was still occupied in 1127."

Explaining the procedure by which the tree-ring calendar was worked out, Dr. Douglass said:

"The method which we have used in extending the historical calendar of the Southwest is the outcome of a long attempt to read the diaries of trees. Every year the trees in our forests show the swing of Time's pendulum and put down a mark. They are chronographs, recording clocks, by which the succeeding seasons are set down through definite imprints. Every year each pine adds a layer of new wood over its entire living surface of trunk and branches.

"If every year were exactly the same, growth rings would tell the age of the tree and little more. Only in rare cases would they record exceptional events of any interest to us. But a tree is not a mechanical *robot;* it is a living thing, and its food supply and adventures through life all enter into its diary. A flash of lightning, a forest fire, insect pests or a falling neighbor may make strong impressions on its life and go into its diary.

"But in the arid regions of our Southwest, where trees are few and other vegetation scarce, the most important thing to man and trees is rainfall. This fact has helped vastly in our dating work, for certain sequences of years become easily recognized from tree to tree, county to county, even from state to state."

From sun spots to tree rings seems a long scientific jump. But it illustrates how one fact of science may have far-flung results in other fields.

"Originally my work was a study of sun spots," Dr. Douglass explained. "It is known that there is a periodicity in their occurrence; they are most numerous at intervals of eleven years. As an aid in that astronomical investigation, I studied trees, for solar changes affect our weather, and weather in turn affects the trees in Arizona's dry climate, as elsewhere.

"The first confirmation of our general interpretation of a relationship between tree rings and sun-spot periods came in a most dramatic way.

"Evidence of the eleven-year sun-spot cycle had been easily found in Arizona pine trees. The regularly recurring periods had been recorded for 500 years by tree rings, *except for the interval from* 1650 *to* 1725. During those 75 years the tree rings gave no evidence of periodical changes in the weather such as were to be expected."

Several years after Dr. Douglass encountered this puzzling fact the late Dr. E. Walter Maunder, an eminent English astronomer, unaware of his findings, wrote to him that he had found that there were no naked-eye sun spots between 1645 and 1715, and that if the tree rings did not indicate some effect of this absence of sun spots, the work was being conducted on an erroneous hypothesis.

The coincidence between the failure of Arizona trees to register any sun-spot effect upon the weather during those years, and establishment of the fact, by entirely independent study, that the customary sun-spot cycle did not occur during approximately the same period of years helped confirm the relationship between the growth of trees and solar changes.

Dr. H. H. Laughlin

Science Follows the Ponies To Discover Future Of Human Race

Genetics

By Helen M. Davis

IN a quiet cove of the Long Island countryside, a group of scientists are following the races. Neither bookmakers nor horses are to be seen there, but form books are there in abundance, and no unlucky amateur better pores over the results of the races with more absorbed interest than do these scholarly men.

More surely than the highest price race tip service, more expertly than the best-informed follower of the "king of sports," these scientists have the "dope." But no leased wires run to the track side, no predictions are merchandised, not a cent is made—or wagered—in bets.

To predict the future of the human race is the goal of the scientists, not the outcome of tomorrow's races. And for guidance in this endeavor, Dr. H. H. Laughlin and his associates have turned to horses, not human beings. For, thanks to racing and the careful breeding of race horses for decades, much more is known about the heredity of horses than of any other living thing on earth.

The aim in life of a race horse is simple, but the number of factors which go to make a horse a success in his chosen occupation may be nearly as great as in the case of a man. The Eugenics Record Office, where Dr. Laughlin and his corps of statisticians work over the horses' records, wants to know what these factors are and by what laws they are inherited. The same laws will throw light on many puzzles of human life—why some win the race and some lose—why some need a special handicap and some are mud-larks, thriving on adversity. In the case of human beings, the most impartial judge cannot evaluate his fellowman's achievements and failures. But in the case of the horse, all are agreed as to just what the race consists of, and the factors can be measured in the numerical form of pounds, seconds and furlongs.

Dr. Laughlin began in 1923 to study the following program: Have the best stallions been consistently bred with the best mares, or have fashion and reputation played an undue part? Has the type of inbreeding practiced been a definite factor in speed production? What influence has the age of the sire, the age of the dam, the order of birth, and the interval between births played in speed production? Can a near-kin index for speed be worked out, by which the probable speed of an animal may be predicted from the records of his relatives?

Files have been compiled on generations of race horses which show up soundness, speed and endurance, and their opposites, inherited in all their combinations. The English thoroughbred horse and its descendants and relatives in Kentucky have furnished the answer to the questions the scientists asked, with the result that breeders thoroughly acquainted with the family records can count on a definite grade of performance from a hypothetical offspring of a given sire and dam.

Of course, practical horsemen have long claimed to be able to do this, but it is one thing to make a claim based on an unanalyzed mixture of hunch, analogy and affection, and suffer frequent disappointments, and quite another to work out by mathematical equations that a certain unborn colt, on a definite type of track, should run so many furlongs in so many seconds, and find that, when he grows up, such is indeed the average speed at which he runs. Such results light the fires of enthusiasm in the eyes of these research workers. They are more thrilling than winning any number of derbies.

A series of formulas have been worked out which give the Biological Handicap of each horse. The Q. P. or quality of performance for a given race by a given individual regardless of age, sex or condition, is a valuable measure. The Futurity Index and its relation to the Near-Kin Index and the Breeding Index give the key to the new generation of racers. The distance-going ability, the weight-carrying ability, the ability in relation to age, the mud-running ability and the energy consumed in relation to speed are being studied.

The results of these studies are being plotted in illuminating curves, requiring four dimensions to portray completely the chief factors of the race—distance run, weight carried, age of the horse and speed at which he runs. And the scientists are quietly laughing in their sleeves at some of the pet notions of the professional handicappers. They have information on which they might go out and beat the races—only they get so much more kick out of the work they are doing.

Professional horse-breeders are naturally interested in the problem of breeding better and faster race-horses, regardless of the general biological

problems involved, and the cooperation of Walter J. Salmon has made possible this program of research with the double goal of improving the American race horse and extending our knowledge of the laws of heredity.

The alliance between the horse-breeder and the research scientist is closer and of longer standing than the casual follower of the ponies might think. Stanford University this year celebrated the semi-centennial of a program of research inaugurated by its founder which has had wider results than were expected at the time. Fifty years ago, the picturesque sportsman and philanthropist, Senator Leland Stanford, in his California home was encouraging a bewhiskered individual who rejoiced in the name of Eadweard Muybridge. At Mr. Stanford's suggestion, Mr. Muybridge was trying to use photography, a discouragingly messy process then with its wet collodion plates, to settle the moot question as to the horse's best gait.

The result of these photographic researches was one of the early forms of the thing which finally evolved into the "movies." A fairly large number of people in the '70's and '80's were tinkering with the idea that if pictures of objects in motion were shown in rapid succession the objects in the picture would appear to take on life. Henry R. Heyl, in 1870, had shown such an effect—the earliest record of a motion picture exhibition which has been brought forward at this writing. Muybridge took his pictures of horses in motion in 1872. Later he combined these pictures with a projection device, and proved to the world that horses do not gallop in the way artists had imagined they did.

Of course, none of these early devices had much in common with the moving pictures of today. Photographic methods at that time were much too crude to suggest the possibilities of today's compact apparatus. And it is doubtful whether Muybridge would have been interested in scenarios and soft-focus effects with blonde curls. He wanted action, and if his "Zoopraxiscope" has a descendant today it must be the slow-motion picture.

Muybridge in his "Descriptive Zoopraxography or the Science of Animal Locomotion" twenty years later described his entry into the field of horse photography. "In the year 1872, while the Author was engaged in his official duties as Photographer of the United States Government for the Pacific coast, there arose in the city of San Francisco one of those controversies upon Animal Locomotion, which has engaged the attention of mankind from the dawn of symbolical design, to the present era of reformation in the artistic expression of animal movements.

"The subject of this particular dispute was the possibility of a horse having all of his feet free of contact with the ground at the same instant, while trotting, even at a high rate of speed, and the disputants were Mr. Frederick MacCrellish and the Hon. Leland Stanford.

"The attention of the Author was directed to this controversy and he immediately sought the means for its settlement.

"At this time the rapid dry plate had not yet been evolved from the laboratory of the chemist, and the problem before him was to develop a sufficiently intense and contrasted image upon a wet collodion plate, after an exposure of so brief a duration that a horse's foot moving with a velocity of more than a hundred lineal feet in a second of time, should be photographed practically 'sharp.'

"A few days' experimenting and about a dozen negatives, with a celebrated fast trotter—'Occident'—as a model, while trotting at the rate of a mile in two minutes and sixteen seconds, laterally in front of the camera, decided the argument for once and for all time in favor of those disputants who held the opinion that a horse while trotting was for a portion of his stride entirely free from contact with the ground. With a knowledge of the fact that some horses while trotting will make a stride of twenty feet or more in length, it is difficult to understand why there should ever have been any difference of opinion on the subject.

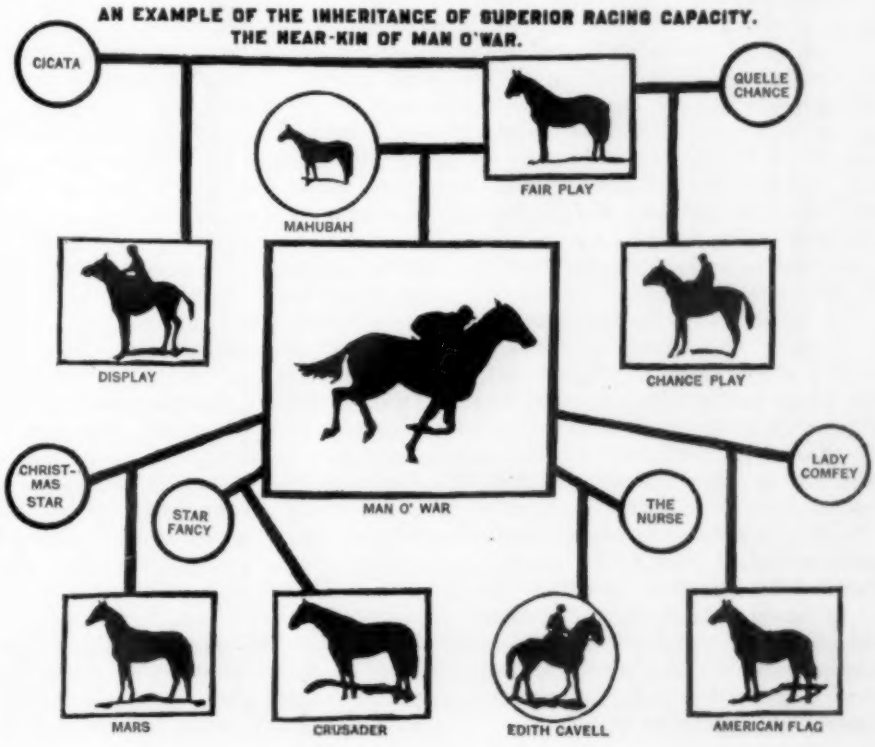
"Thus far the photographs had been made with a single camera, requiring a separate trotting for each exposure. The horse being of a dark color and the background white, the pictures were little better than silhouettes, and it was difficult to distinguish, except by inference, the right feet from the left.

"Several phases of as many different movements had been photographed, which the Author endeavored with little success to arrange in consecutive order for the construction of a complete stride.

"It then occurred to him that if a number of cameras were placed in a line, and exposures effected successively in each, with regulated intervals of time or of distance, an analysis of one single step or stride could be obtained which would be of value both to the Scientist and the Artist.

"The practical application of this system of photographing required considerable time for its development, and much experimenting with chemicals and apparatus."

The final form of this apparatus had a battery of 24 cameras side by side, the exposures being made by a curious device (*Turn to page* 374)



X-Rays Contribute To Medicine

Medicine

Radiologists See Movies of Lungs at Work

Great increase in the number of cases "cured" of bone cancer in recent years is attributed by Dr. Joseph Colt Bloodgood of Baltimore to X-rays and to popular education in their value. Dr. Bloodgood and Dr. Russell L. Haden of Kansas City have been awarded the gold medal of the Radiological Society of North America for their work with X-rays.

"Before the discovery of the X-rays there was rarely if ever a verified cancer of bone cured by amputation," Dr. Bloodgood said. "Since the discovery of the X-rays and up to 1921 the actual cures of cancer of bone, in the records of the Johns Hopkins Hospital Surgical Pathological Laboratory, were four per cent. Today, now that more people know the importance of an immediate examination after the slightest warning or injury to a bone, the cures have increased to thirty-five per cent."

Over one-third of the persons treated at hospitals for bone cancer since 1921 have lived for at least five years without any recurrence of the disease. Apparently they have been "cured."

The warnings of cancer of the bone are not different from the warnings of troubles of the bone that are not cancer, Dr. Bloodgood said. Pain or discomfort of some kind, swelling or slight loss of function should be investigated immediately and X-ray examination should be part of the investigation. This is particularly important after accidents or injuries, even if no break in the bone is apparent. Slight breaks and injuries of bones can be disclosed by the X-ray which, if undiscovered and untreated, might lead to serious trouble later on, Dr. Bloodgood warned.

The X-ray plays an important part in locating the source of infection causing many cases of chronic infective rheumatism, Dr. Laurence H. Mayers of Chicago told members of the Radiological Society of North America at their recent meeting in Toronto.

"Chronic arthritis is far more easily prevented than cured. It is always preceded by infection, usually a focus of infection. This focus is usually accessible for surgical removal and in most cases may be located by radiographs, as in the teeth and accessory sinuses," Dr. Mayers stated.

A normal human lung rids itself of foreign material by means of a peculiar rhythmic motion of the bronchial tubes, Dr. H. A. Jarre of Detroit reported. This discovery was made with the aid of a new X-ray motion picture camera.

"The pictures we take are slow motion because the organic movement in the body will only tolerate a limited amount of X-ray energy," Dr. Jarre explained. The new machine is to be called the Cin-Ex Camera. The pictures are taken at the rate of one to four seconds, while the regular picture camera takes sixteen exposures per second.

Dr. Jarre reported that he and his associates discovered a peculiar rhythmic motion phenomenon of the bronchial tubes during breathing "so that in a normal human lung foreign materials and excretions as well as air are expelled by these movements alone."

"Cancer and ulcer of the stomach are the two most common diseases encountered in this organ and are easily recognized by means of the X-rays," Dr. Maurice Feldman, associate professor at the University of Maryland Medical School, declared at the meeting.

"When the disease has already resulted in destruction of tissue, the condition may be easily recognized," said Dr. Feldman, speaking of stomach cancer. "But this is often a late stage of the disease.

"X-rays offer the earliest positive diagnostic signs of cancer, which can in no other way be determined. The necessity of a thorough X-ray examination is extremely essential in every case of digestive disturbance which is not promptly relieved by ordinary remedies."

X-rays and radium are daily saving the lives of many babies who have enlarged thymus glands, Dr. Howard P. Doub of the Henry Ford Hospital, Detroit, and Dr. H. B. Podlasky of Milwaukee stated.

"When a baby strangles or becomes blue or has a hoarseness or a cough, it may have enlarged thymus," they said. "The thymus gland, located just above the heart, which functions as an aid to the growth and development of the child, may become a dangerous organ and cause abnormality or death due to asphyxiation if it develops into an abnormally large thymus. This is especially dangerous to children and frequently causes death. It may also cause a fatality during operative treatment while the child is under anesthesia. The gland, however may be reduced and made harmless by the use of X-ray and radium treatment."

Dr. Podlasky, with his colleague, Dr. G. W. Stevens, studied the chests and thymus glands of 750 babies.

"One-third of all new-born infants show signs of enlarged thymus," Dr. Stevens reported. "In this study only about seven and one-half per cent. of the cases showing enlarged thymus glands showed symptoms sufficient to cause recognition of the enlarged thymus by a physician. This is important as in a symptomless child having enlarged thymus serious results might follow operation under anesthesia. It has been definitely shown that the X-ray produces very beneficial results upon these enlarged thymus cases and there is definite relief to be expected from X-ray treatment."

Experiments to toughen the skin or decrease its sensitivity to X-rays, which are being made in the hope of increasing the amount of radiation used for treating tumors of the body, were described by Dr. Edith H. Quimby and Dr. George T. Pack of New York City.

In treating deep tumors by radiation, either X-ray or radium, the rays must pass through skin and normal tissues before reaching the diseased ones, Dr. Quimby explained. The amount that can be used in treatment is limited by the amount the skin will tolerate. This amount is frequently not enough to have the desired effect on the tumor.

The effects produced on the skin with a constant quantity of radiation were estimated in 100 tests. It was found that it took one-third more radiation to produce a mild effect on the skin when both hard and soft X-rays and hard and soft radium rays were used in equal proportions than when either one alone was used. This demonstrated a real increase in skin tolerance which could not be explained on purely physical grounds, Drs. Quimby and Pack concluded.

Carnegie Institution's Researches

Geodesy

Magnetic Exhibit Memorial To Ill-Fated "Carnegie"

The first monument to Capt. James P. Ault of the Carnegie Institution of Washington, who was killed when his ship, the non-magnetic "Carnegie," was destroyed by explosion and fire in Apia Harbor, Samoa, on November 29, will consist of his own work and that of his associates, which will form a special section of the institution's annual exhibition, opening in Washington on December 14.

The central figure of the memorial exhibit will be a large globe, on which will be traced the long wake the "Carnegie" left on the seven seas during her twenty years and more of voyaging. Further exhibits will show how the data on the magnetism of the earth gathered on these cruises have been put to use in scientific work and in the highly practical field of guiding ships safely to port. There will also be a model of the apparatus used to correct the compass determinations against the errors introduced by the roll and pitch of the ship, as well as displays of specimens, photomicrographs, microscope slides and graphs illustrating the many studies conducted by the scientific staff of the "Carnegie" on the physics and biology of the ocean and the geology of its bottom.

The annual exhibition of the Carnegie Institution is one of the outstanding events of the scientific year in Washington, and attracts many visitors from all parts of the country. In addition to the memorial exhibit of the work of the ill-fated "Carnegie," there will be displays of the work of other departments.

When the "Carnegie" burned as the result of a gasoline explosion in the harbor at Apia, Samoa, killing Capt. Ault, an important scientific program was interrupted when only about half completed. One of the most valuable parts of the cruise, across the South Pacific at about 60 degrees latitude, was to be made next month.

Scientific records obtained on the voyages of the ship have been mailed back as she touched various ports. As the ship had been at Samoa for several days, it is presumed that all of the latest data had already been mailed, and that none of the scientific records were destroyed. W. C. Parkinson, senior scientific officer under Capt. Ault, and who has been made acting commander, reported to the institution that the destruction of the ship was complete, and that only the cash and the ship's books had been salvaged.

The main purpose of the "Carnegie" was to make magnetic observations in all of the seven seas. Because the magnetic poles of the earth, towards which the compass needle

CAPTAIN JAMES AULT

points, are not at the geographical poles, the compass does not point directly north or south. Instead there is a certain declination for every point on the earth's surface, which is the angle that it deviates from a north and south line. This must be allowed for by navigators of ships and by surveyors on land. As the magnetic poles do not remain in the same place, the declination at any point constantly varies. Previous voyages of the "Carnegie" had determined these values for the first time in many points in the oceans. In 1915, Capt. Ault took the "Carnegie", then on its fourth cruise, around the south polar regions in the latitudes between 50 and 60 degrees south. During the coming months it had been planned to cover much of the same track, to determine the variations in the last 15 years. In fact, many parts of the route for the present cruise were planned to duplicate previous tracks, for the same reason.

Though magnetic observations of declination, intensity, etc., were the first purpose of the "Carnegie's" voyages, and the reason why it was especially built with scarcely a ton of iron or steel in its makeup, to avoid interference with the delicate magnetic instruments, many other researches entered into the program. Observations of the electricity in the atmosphere, of the cosmic rays that constantly bombard the earth from outer space, of the relation of these things to radio reception, of the depth of the ocean over which they sailed, and biological studies of the organisms in the ocean were also in progress.

On May 1, 1928, the "Carnegie" left Washington for what was intended to be a three-year cruise. On board was a crew of 17 and a scientific staff of seven. The first leg was across the Atlantic to England and Germany, where some additional instruments were obtained. Then she sailed to Iceland, south of Greenland, down the Atlantic and through the Panama Canal into the Pacific. Thence she cruised around the Pacific, finally reaching Japan, and returned to San Francisco last summer, having covered 33,000 miles. Leaving San Francisco on September 3, she sailed to Honolulu and then to Apia, covering an additional 8,100 miles.

Capt. Ault of the "Carnegie" never saw the ocean until he was 24. Since then he sailed some 200,000 miles, in all the oceans of the world. He piloted the "Carnegie" over 160,000 miles before embarking on its last ill-fated cruise.

Born in Kansas in 1881, Capt. Ault studied at Baker University, in Baldwin, Kansas. While there he acted as magnetic observer for the U. S. Coast and Geodetic Survey. In 1905 he made his first scientific ocean voyage on the Survey's ship "Bache." Later in the same year he sailed on the Carnegie Institution's first floating magnetic observatory, the brigantine "Galilee", which had been chartered for the purpose. The "Carnegie" was then built especially for the purpose with bronze nails and machinery and a minimum of iron and steel. It was a sailing ship, but with an auxiliary engine. On the "Carnegie's" third voyage, in 1914, Capt. Ault took command, which he retained on subsequent voyages, except for a short one in 1917.

Electric Eye

Constantly measuring the smoke and haze in the Holland Tunnel under the Hudson River connecting New York and Jersey City is the latest job for science's magic lamp, the photoelectric cell, that has made television and talking movies practicable.

Above the main tube of the tunnel, through which traffic passes, is an exhaust duct, a long, cave-like chamber near the New York end. Through this duct is drawn the exhaust air from the tunnel. The duct is at the point where the roadway grade is greatest and where there are the most exhaust gases from the heavy truck traffic. Except for the light admitted through the air openings, the duct is dark.

Here General Electric engineers have installed experimentally a photoelectric device to measure the smoke and haze. A large box contains a lamp and a photoelectric cell in adjacent compartments, light-tight except for a lens at the front of each. The lens in front of the light makes a narrow beam, which shines on a mirror 150 feet away. Thence it is reflected to a second mirror and back to the box, where the other lens focusses the light on the cell. The current from the cell is amplified by vacuum tubes, and passes over wires to the recording device in the tunnel office a half mile away. Here it controls the movement of a pencil over a moving strip of paper.

When the amount of smoke in the air duct increases, the intensity of the light returning to the photoelectric cell is reduced, and the moving pencil immediately indicates the fact. Then the tunnel engineers can turn on more of the ventilating fans to keep the air clear.

Uses for such a device in homes and business offices are foreseen, where it can be used to detect smoke and act as a fire alarm. For some time the Holland Tunnel has used a somewhat similar device to count traffic, by the interruptions by automobiles of a beam of light across the exit.

Physics
Science News-Letter, December 14, 1929

Sun Spots

After a solar disturbance that set a record for recent years, the sun is now becoming relatively inactive, photographs at the U. S. Naval Observatory show. The huge spot, 40,000 miles in diameter, that crossed the center of the sun's disc on Nov. 30 was carried by the sun's rotation to the western edge and disappeared from view on Dec. 7. This spot was part of a general disturbed region 700,000 miles long, which is also passing out of sight. If it survives, the rotation will carry it into view again on the eastern side about Dec. 21.

A single spot of sizable diameter, that crossed the face of the sun about three weeks ago, came into view again on the eastern side last week. The recent spots apparently produced no magnetic effects or northern lights on the earth, as sometimes happens when a large spot crosses the sun.

Astronomy
Science News-Letter, December 14, 1929

Turtles

There is a rather widespread opinion that turtles grow very slowly and live a long time. This belief is strengthened when an occasional turtle is found by some man who, when a boy, cut his initials and the date on the under surface of the shell. In such instances the turtles seem to have grown very little during the long interval.

Recent observations by Prof. G. H. Parker of Harvard University throw evidence upon this question. Prof. Parker noted that, at birth, loggerhead turtles weigh less than one ounce; three years later they weigh about forty-two pounds; in other words, this species of turtle attained one-fourth of its adult weight during the first three years of its life. These observations indicate, therefore, that turtles grow very rapidly in early life but that the rate of growth is retarded later.

Zoology
Science News-Letter, December 14, 1929

5,000 Butterflies

A tale like that of a modern Marco Polo, braving bandits, famine, and the perils of the wilderness to bring home to the West a cargo of the spoils of the East, is told by Herbert Stevens, of the Field Museum of Natural History, who has just got home from China. Only his booty does not consist of jade and pearls, silks and spices, but of the skins and bones of birds and animals. It was to bring out these spoils of science that he travelled 1700 miles through famine-stricken and thief-infested territory, going on foot, on horseback, on muleback, on yakback.

Mr. Stevens was leader of one division of the William V. Kelley-Roosevelt expedition of the Field Museum, and his adventures are related by Director Stephen C. Simms of the museum. All the other divisions of the expedition have preceded him on the homeward trek, and he was the sole white man left in charge of the great accumulations of biological specimens, with the task of getting them out intact. This he accomplished successfully, his journeyings taking him through the little known interior provinces of Yunnan and Szechuan, and along the Tibetan border.

Now safely returned to the Field Museum, Mr. Stevens is superintending the unpacking of his cases and bales. There are thousands of valuable specimens, many of them rare, some quite new to science. There are in the collection approximately 500 mammals, 1100 birds, 500 reptiles and fishes, 5,000 butterflies, 2,000 moths, 500 beetles and bugs and 10,000 plant specimens.

Biology
Science News-Letter, December 14, 1929

IN VARIOUS FI

Heart Beat

The potassium in the diet is the radioactive element which normally performs the vital function of starting the heart beat, it appears from experiments conducted in the laboratory of Dr. H. B. Zwaardemaker, professor emeritus of physiology at the University of Utrecht. These experiments have just been reported by Dr. Charles C. Lieb, professor of pharmacology at the College of Physicians and Surgeons, Columbia University, who has himself spent some time on research in Dr. Zwaardemaker's laboratory.

Earlier experiments of Dr. Zwaardemaker seem to have definitely established the fact that potassium is a radioactive element. The recent experiments have indicated that a radioactive element is essential in the initiation of the heart beat, and therefore an indispensible element of diet.

Pursuing these studies further, Dr. Lieb will investigate the pharmaceutical value of radioactive spring waters, such as those found at Saratoga Springs, Arkansas Hot Springs, the Georgia springs owned by Governor Roosevelt of New York, where infantile paralysis cases are treated, and many other famous spas throughout the country. For years it has been known that the waters of these springs were radioactive, but the active charges

have been so small that leading radium authorities have considered their radioactivity a negligible quantity therapeutically.

Dr. Zwaardemaker's work, Dr. Lieb pointed out, not only indicates that the radioactivity of potassium is one-millionth to one-hundred-millionth that of radium, but that even this minute charge is essential to the maintenance of the heart beat.

Chemistry—Physiology
Science News-Letter, December 14, 1929

Roman Map

Plans for making a great historic map of the Roman Empire have been announced by an international commission of geographers. The commission was appointed to publish the map by the International Geographical Congress, several months ago.

The map sheets will show cities and other geographical features which figured in the development of the Roman Empire from the time the Romans appeared in any region to the fall of the Western Empire. Both ancient and modern names will be given. Distribution and types of population will be indicated, as well as important economic and social conditions. The sheet containing the city of Rome is now in the process of preparation, the commission reported.

Cartography
Science News-Letter, December 14, 1929

Drug Addicts

The prevailing belief that a person who contracts the drug habit will go to pieces mentally and nervously if he is suddenly deprived of his customary narcotic dose has been considerably exaggerated, judging by psychological experiments with drug addicts conducted by Prof. R. W. Paynter of Long Island University.

Prof. Paynter gave various psychology tests to addicts who have been victims of the drug habit for from one to twenty years. The men were tested after they had taken a dose of morphine and were "comfortable," and again when they had been deprived of the drug for ten to twelve hours. They were asked to do arithmetic problems, to memorize facts, to do tasks requiring coordinating of muscles, and to take tests of their intelligence.

The men performed the tests far better than was expected, the psychologist reported. When they were set to work after being suddenly deprived of the drug there was no serious mental confusion or disintegration, he found, though the addicts experienced some physical and mental distress. In some instances they made better records on the tests in the period of abstinence than after taking the drug.

Psychiatry
Science News-Letter, December 14, 1929

Remembering Pi

"How I want a drink, alcoholic of course, after the heavy chapters involving quantum mechanics."

This hypothetical appeal of the American scientist, who had just finished reading a book on modern physics, is the latest method of remembering the value of "pi", the famous number by which the diameter of a circle must be multiplied in order to find its circumference. Write under each word the number of letters it contains, and you have 3.14159265358979, which is the value of this number, expressed with far greater accuracy than the ordinary 3.1416.

The Observatory, English astronomical journal, gives this sentence, along with several others of a similar nature, in "An Oxford Note-Book", in its November issue, with the remark that it is adapted to the United States. J. H. J. is given as the author, and the initials happen to be the same as those of Sir James H. Jeans, leading British astronomer, formerly president of the Royal Astronomical Society and secretary of the Royal Society.

Another sentence for remembering the number called "e", or "the base of the Napierian logarithms", is also given: "To Napier's *e* reciting so ordinary a sentence an easiness gives." The number is 2.7182818285.

Mathematics
Science News-Letter, December 14, 1929

Inca Copper

What is now the world's largest known copper ore deposit was worked by the prehistoric Incas, judging by remains that have been found at and near the copper mines of Chuquicamata, Chile.

Within the mine primitive tools have been found from time to time, such as stone hammers and wooden shovels, as well as mummified remains of early Indian miners, one of which is now at the American Museum of Natural History in New York.

The ruins of Pucaro, an ancient fortified city destroyed by the Spaniards during their first invasion of Chile, are 25 miles from Chuquicamata. Ancient graves belonging to this prehistoric city have yielded bowls and other utensils of copper as well as bead necklaces made from brochantite and atacamite, minerals characteristic of the chuquicamata deposits.

The Incas, reputed as pre-Columbian America's best miners and metal workers, conquered this part of Chile about 1443, it is reliably believed, and the old mines may therefore have been worked at least ninety years before the discovery of America.

Archæology
Science News-Letter, December 14, 1929

Rats and Students

Twenty college students and forty-three white rats have been given the same task to learn by a psychologist who wanted to compare rats and men. The rats were turned loose in a maze with a food reward at the other end. The students, blindfolded, traced the same maze pattern with their fingers, but got no dinner reward for success.

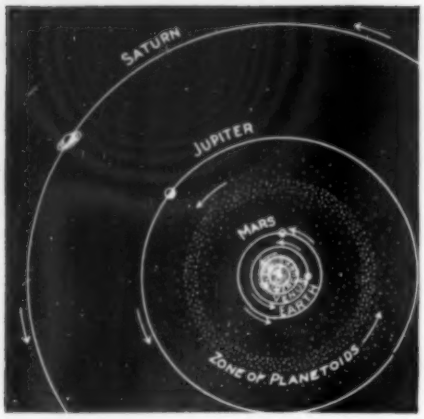
Results of the experiment, reported in the *Journal of Comparative Psychology* by R. W. Husband, psychologist at the University of Illinois, show that the students were quicker than the rats at learning the maze route.

The students, who were familiar with the idea that maze paths turn right and left confusingly, tended to make mistakes by taking alternate turns to right and then to left too regularly. The rats erred most frequently by taking left turns persistently because one left turn proved correct, or else taking too many right turns.

Rats, as well as students, appeared to exercise some ideation in solving the maze, though in the animals the process is rudimentary, the psychologist suggests. Rats that had tried the maze a number of times and were learning its turns would run into the entrance of a blind alley, and then stop suddenly and change direction into the correct path.

Psychology
Science News-Letter, December 14, 1929

The vitalizing power of ultra-violet light was discovered by accident in 1901, when operators of lamps used in experiments became severely sunburned.



Discovery of the Asteroids —A Science Classic

Astronomy

If the discovery of one new planet in 1781 brought amazement to the world and lasting fame to its discoverer, Sir William Herschel, how much more it must have astonished astronomers some twenty years later to find a whole nest of planets, and those all in the same place, astronomically speaking. The diagram on the left shows the position of the belt of asteroids in comparison with the orbits of their neighbors in our solar system. More than one thousand asteroids are now known.

THE ZONE OF SMALL PLANETS BETWEEN MARS AND JUPITER. By Professor Elias Loomis, of the University of New York. In the Ninth Annual Report of the Smithsonian Institution. Washington, 1855.

Seventy-five years since, the only planets known to men of science were the same which were known to the Chaldean shepherds thousands of years ago. Between the orbit of Mars and that of Jupiter there occurs an interval of no less than three hundred and fifty millions of miles, in which no planet was known to exist before the commencement of the present century. Nearly three centuries ago the immortal Kepler had pointed out something like a regular progression in the distance of the planets as far as Mars, which was broken in the case of Jupiter. Being unable to reconcile the actual state of the planetary system with any theory he could form respecting it, he hazarded the conjecture that a planet really existed between the orbits of Mars and Jupiter, and that its smallness alone prevented it from being visible to astronomers. But Kepler himself soon rejected this idea as improbable, and it does not appear to have received any favor from the astronomers of that time.

An astronomer of Florence, by the name of Sizzi, took decided ground against all such innovations of doctrine. He maintained that since there are only seven apertures in the head—two eyes, two ears, two nostrils, and one mouth—and since there are only seven metals, and seven days in the weeks, so there can be only seven planets. These seven planets, according to the ancient systems of astronomy, were Saturn, Jupiter, Mars, the Sun, Venus, Mercury, and the Moon.

In 1772, Professor Bode, of Berlin, first announced the singular relation between the distances of the planets from the sun, which has since been distinguished by the name of Bode's law. This law exhibited in a striking light the abrupt leap from Mars to Jupiter, and suggested the probability of a planet revolving in the intermediate region. This conjecture was rendered still more plausible by the discovery in 1781 of the planet Uranus, whose distance from the sun was found to conform nearly with the law of Bode. In Germany, especially, a strong impression had been produced that a planet really existed between Mars and Jupiter, and the Baron de Zach went so far as to compute the orbit of the ideal planet, the elements of which he published in the Berlin Almanac. In the year 1800, several astronomers, of whom the Baron was one, formed an association whose object was to effect the discovery of the unseen body. For this purpose the zodiac was divided into twenty-four zones, one of which was to be explored by each astronomer. Soon after the formation of this society the planet was discovered, but not by any of those astronomers who were engaged expressly in searching for it. Piazzi, the celebrated Italian astronomer, while engaged in constructing his great catalogue of stars, was induced carefully to examine, several nights in succession, a part of the constellation Taurus, in which Wollaston, by mistake, has assigned the position of a star which did not really exist. On the first of January, 1801, Piazzi observed a small star which, on the following evening, appeared to have changed its place. On the third, he repeated his observations, and he now felt assured that the star had a retrograde motion in the zodiac. He continued to observe the star until the 11th of February, when he was seized with an illness which interrupted his labors. After the planet had approached too near the sun to admit of further observations for that season, Piazzi communicated to astronomers all his observations. Professor Gauss found that they might all be satisfied by an elliptic orbit, of which he computed the elements. The planet was rediscovered on the 31st of December, almost exactly in the place which had been predicted by Gauss; and it received the name of Ceres.

The distance of Ceres from the sun was found to be almost exactly the same as had been assigned by Bode's law. In this respect, therefore, the newly discovered planet harmonized with the other bodies of the system to which it belonged. The new planet was, however, excessively minute, its diameter, acording to Herschel's measurements, amounting to only one hundred and sixty-one miles.

The discovery of this planet was soon followed by another of a similar nature. Dr. Olbers, while engaged in searching for Ceres, had carefully studied the positions of all the small stars lying near her path. On the 28th of March, 1802, after observing Ceres, he swept over the vicinity with an instrument termed a "comet seeker," and was astonished to find a star of the seventh magnitude in a position where he was sure no star had been visible the preceding month. In less than three hours, he found that its place had changed. On the following evening he looked again for his star, and found that its motion was unquestionable. The elements of its orbit were soon determined by Professor Gauss, who found that its distance from the sun was nearly the same as that of Ceres; and it received the name of Pallas.

A comparison of the relative magnitudes of the planetary orbits had suggested the existence of an unknown planet revolving between Mars and Jupiter. Instead of one planet, however, two had been discovered.

Olbers remarked that there was a point where the orbits of these two bodies approached very near each other; and he conjectured that they might possibly be the fragments of a larger planet, which had been split in pieces by some tremendous catastrophe; and he intimated that there might be many more fragments which had not yet been discovered. He also inferred that, according to this theory, the orbits of all the fragments would have two common points of intersection situated in opposite parts of the heavens, through which every fragment must pass in the course of each revolution. He therefore proposed every month to search carefully the two points of the heavens in which the orbits of Ceres and Pallas were found to intersect each other. The speedy discovery of a third planet tended to confirm the truth of this hypothesis.

On the 1st of September, 1804, Professor Harding discovered a small star very near the place where Olbers had asserted that the fragments of the shattered planet must all pass. On the evening of the fourth he found that the star had changed its place. This planet was named Juno. Its orbit was computed by Gauss, who found its distance from the sun to coincide nearly with those of Ceres and Pallas.

Stimulated by this new discovery, Olbers continued with unwearied assiduity to explore the two regions of the heavens already referred to, and, after three years of laborious search, his perseverance was crowned with success. On the 29th of March, 1807, he discovered a small star in a place where none had been found in his previous examinations. He soon satisfied himself that this object was a planet; and it received the name of Vesta. The elements of the orbit were determined by Gauss, who found its distance from the sun to be a little less than that of Ceres, Pallas, or Juno.

Dr. Olbers continued his systematic examination of the heavens until 1816, but was rewarded by no further discoveries.

In 1825, a fresh impulse was given to researches of this nature by the resolution of the Berlin Academy, to procure the construction of a series of charts showing the position of all stars down to the ninth magnitude situated within fifteen degrees of the equator. Only about two-thirds of the charts contemplated in this great undertaking have yet been executed.

After the discovery of Vesta, succeeded a long interval of thirty-eight years, during which the excitement created by these first discoveries subsided, and the search for new planets was generally abandoned.

At length, in 1845, a fifth asteroid was announced by an observer hitherto unknown to fame, Hencke, of Germany. In 1847, the same observer announced a sixth asteroid, and from this time numerous observers in every part of Europe devoted much of their time, while some devoted nearly all of their energies to the search for planetary bodies; and discoveries at once multiplied with astonishing rapidity. Three new asteroids were discovered in 1847, one in 1848, one in 1849, three in 1850, two in 1851, eight in 1852, four in 1853, and six have been announced during the year 1854, making at the present time a total of thirty-three. Of these thirty-three, ten were first discovered by Mr. Hind, of London; seven by Dr. Gasparis, of Naples; three by Luther, of Bilk; while Dr. Olbers, of Bremen, Hencke, of Driesen, Chacornac, of Paris, and Goldsmith, also of Paris, have each of them discovered two asteroids; and Piazzi, Harding, Graham, Marth, and finally Ferguson, of our own National Observatory, have each discovered one. Moreover, in several instances, the same planet has been independently discovered by more than one astronomer.

In scarcely a single instance could these discoveries be termed the result of accident. They have been the result of a laborious search expressly undertaken for the discovery of these bodies. Mr. Hind, who has been the most successful explorer in this field, nearly ten years ago commenced comparing the Berlin charts with the heavens, and began to map down for himself the stars in other regions of the ecliptic, which did not fall within the limits of the Berlin charts. Any discrepancy between the stars on the maps and the stars in the heavens was carefully scrutinized; so that if a new star presumed to show itself within the limits of the charts, it was at once pounced upon as an unlicensed wanderer.

The discoveries of Gasparis were also made partly by comparing the Berlin maps with the heavens, and partly by a series of observations in zones of declination, made for the express purpose of finding new planets. Nearly all the asteroids have been discovered by a systematic comparison of the visible state of the heavens, with the state as recorded in charts.

The rapid discovery of twenty-nine new asteroids, after a barren interval of almost forty years from the discovery of Vesta, is calculated to excite surprise; but it is explained by the diminutive size of the new planets, and the great increase in the number of observers, as well as the use of more powerful instruments. Vesta appears like a star of the sixth magnitude, Pallas of the seventh, while Ceres and Juno are of the eighth. Of the twenty-nine asteroids more recently discovered none of them, with perhaps two exceptions, are larger than the ninth magnitude, while several are as small as the tenth, and one or two scarcely, if ever, rise so high as the tenth magnitude. The reason that Olbers was not more successful in his search was that he employed a telescope of too feeble power, and did not extend his examination beyond stars of the eighth magnitude.

Some may conclude that the number of asteroids already known is so great that the discovery of additional ones is a matter of no interest, and is unworthy the attention of astronomers. I regard the question in a very different light. If only one planet had hitherto been discovered between Mars and Jupiter, our idea of the simplicity and perfection of the solar system would have been satisfied; and there might have been found ingenious minds attempting to prove by a priori reasoning, that no other planets could possibly exist, unless beyond the limits of the orbit of Neptune. But our theory (*Turn to page* 374)

An asteroid made the trail in the center of the picture by moving during the time the plate was exposed. The fixed stars show as points of light. This photograph was made by Max Wolf, champion asteroid catcher.

3000° "Sleet" Storm For Mirror

Astronomy

"Sleet storms" at 3,000 degrees Fahrenheit, in which a layer of clear transparent quartz is coated on a base of white quartz by an oxy-hydrogen blowpipe, much the same as a clear layer of ice is sometimes coated on trees in a rainstorm in cold weather, may make possible the new 200-inch telescope, planned for the California Institute of Technology.

Speaking before the American Philosophical Society at Philadelphia, Dr. Elihu Thomson, director of the General Electric Company's research laboratory at Lynn, Mass., told of his researches on methods of making the huge mirror. This mirror, 200 inches or sixteen and two-thirds feet in diameter, will be the heart of the telescope. It will be twice the diameter of the largest telescope mirror ever made before.

Unlike the ordinary small telescope, the new instrument will be a reflector, in which a dish-shaped mirror concentrates the rays of light from a distant star into a point on the photographic plate or in the eyepiece through which the astronomer looks. The final curve of the mirror must be ground very carefully, so that it will have exactly the right shape, and give a sharp image.

Glass is the most popular material for telescope mirrors at present, but it has some disadvantages, pointed out Dr. Thomson. Changes in temperature produce a considerable change in the size of the glass. When any grinding is done, the friction heats the mirror. Then it must be allowed to cool before it can be tested, all of which consumes much time. And then, when the figure has been completed, and the telescope is in use, slight changes of temperature produce considerable changes in the image seen in the instrument.

Therefore, said Dr. Thompson, "it is not glass that we shall use, but fused silica, or melted quartz, melted in an electric furnace at between 1,700 degrees and 1,800 degrees Centigrade, which means more than 3,000 degrees Fahrenheit, or about the melting point of platinum, a metal difficult to melt, as is well known, and which does not melt in ordinary flames or furnaces. The method we shall use, and which we are using, in fact, on a small scale with great success, is, in general terms, one devised quite a number of years ago, and which consists in first melting a mass of good clean quartz sand in a circular mould in an electric furnace, and obtaining thereby a disc or thick slab of melted quartz sand. This is, indeed, fused quartz, but full of tiny bubbles, which tend to make it lighter, but the melted sand has all the desirable properties of the solid fused quartz itself."

Quartz has the advantage that it retains practically constant size for all ordinary temperatures. This makes a quartz mirror easier to figure, and to use after completion. But the rough quartz disc, full of bubbles, will not take the smooth silver coating that reflects the light rays to a focus.

"This comparatively rough bubble-filled mass of melted sand, which is the underlying disc, has to be provided with a surface layer, more or less thick, of clear glass-like fused quartz, or silica glass," continued Dr. Thomson. "It will have the same general properties, so far as expansion goes, and, therefore, will suit the purpose very well united to the sand backing. The first efforts were made by melting on to the fused sand backing slabs of clear quartz made in a different way, and the results were fairly successful. Fair mirrors could be made in that way, but at the suggestion of one of our skilled workers, an experiment was made of feeding into an oxy-hydrogen blowpipe flame, granulated or finely powdered crystal quartz (rock crystal) of high quality, and immediately it was found that a coating of clear quartz could thus be deposited upon any other piece of quartz. When oxygen and hydrogen are burned in a jet, the temperature of the flame is high enough to fuse or melt silica, or quartz. By raining down through such a flame, the granulated crystal quartz is received on a surface much as ice deposits in clear layers on objects during a sleet storm. In illustration, I often use the analogy, only adding that ours is a high temperature sleet storm, with quartz deposited in clear layers instead of ice.

"Extending this to a mirror, it was found that under proper precautions of temperature, the surface might be glazed with clear fused silica to any ordinary desired thickness, by the simple process of introducing high grade silica into a flame of such temperature as will melt readily the particles of silica as they pass through it towards the surface which receives it. In this case, of course, it is the surface of the mirror to be, as composed of the fused sand backing, which in the way I have outlined is covered with a layer of beautiful, clear, transparent fused quartz."

Science News-Letter, December 14, 1929

Earth To Grow Rings

Astronomy

The rings of Saturn, now unique in the heavens, as far as astronomers know, may be rivalled by a similar system around the earth in the dimly remote future, Dr. Harlow Shapley, director of the Harvard College Observatory, believes.

"For some years we have been familiar with the fact that the earth's rotation is slowing down, that the day is lengthening, and that the moon is receding," said Dr. Shapley in a lecture at the College of the City of New York. "We have learned that after an interval of some fifty thousand million years the month and the day will be the same length again, as they were at the time the earth-moon system was formed. This equality of month and day in the future will be forty-seven of our days in length; at the time of the origin of the moon from the earth it was less than five of our present hours in length.

"According to calculation, the moon will ultimately return to the earth, and in the dimly remote future its fate will be disruption by the tidal forces of the earth and transformation into a ring system of myriads of moons such as that now observed around Saturn. This process may fail of completion if in the meanwhile the sun's stores of energy have become exhausted and our oceans have become frozen, stilling the tides which are involved in the machinery of the evolution of days and months. The irregularities are probably due to pulsations of unknown origin in the earth's crust."

Though so close to us, compared with the stars, and though such a vast number of observations have been made of them, the planets and moons associated with the earth in the sun's family present some of the most baffling astronomical mysteries, Dr. Shapley said.

Science News-Letter, December 14, 1929

NATURE RAMBLINGS

By FRANK THONE

Cedar Waxwing

Of all our bird winter boarders, the cedar waxwing has, perhaps, the best claim to the beauty prize. His the most graceful shape, his the smoothest, silkiest feathers. Most of his coat is of browns and fawn shades in the most delicate nuances, but he breaks out in bits of bright color at just the right places. Black under his throat, and a narrow black mask about his eyes beneath his neat little crest; the black edged with a thin strip of white and this set off with just a suggestion of vermillion; could any bird's head be handsomer? Black and white and red again about the edges of his wings and tail—only this time a scarlet instead of vermillion; where does this bird achieve such *savoir faire* in the matter of clothes? And the tail always tipped with clear yellow.

What is more, Mrs. Cedar Waxwing is allowed a larger share in this sartorial splendor than usually falls to female birds. She even has a crest, though it lies back smoothly instead of standing erect like her husband's.

Elegant in dress, the waxwings are also courteous in their manners. They are social birds, always forming friendly little parties of six or eight, talking amiably in low tones, and politely passing refreshments. Several astute bird watchers state that they will pass a cherry from bill to bill, clear along a half-dozen of them sitting on a twig, without any member of the group offering to eat even a part of it. They destroy considerable numbers of insects, but for the most part they are vegetarians.

Science News-Letter, December 14, 1929

Mercury is an exception among metals, in that it is recovered without smelting, being distilled at the mines and shipped as a finished product.

Progress in Microscopy

FIFTY-SIX years ago the Bausch & Lomb Optical Company placed on the market the first microscope that was within the means of the average scientist.

Since that time the progress of methods in manufacture has kept pace with the advance in the performance and quality of B & L instruments until now the FS microscope is available at an exceedingly reasonable price.

Yet you will find that the FS is a high-grade compound microscope. It is equipped with coarse and fine adjustments. The fine adjustment is of the B & L patented side lever type and ceases to act when the objective touches the slide. An iris diaphragm is provided.

Send for complete information on this and our other models for use in elementary, laboratory and research work.

Bausch & Lomb Optical Company

697 Saint Paul Street **Rochester, N. Y.**

Science Follows the Ponies—*Continued*

which Muybridge called the "electro-photographic exposor." In this an endless belt was suspended in front of the lens. The belt was of rubber cloth, wide enough to cover the lens, and having two holes which would pass each other as the belt was turned. The rate at which they would pass was determined by the number of rubber bands attached to pull the belt when the mechanism holding it was tripped. The tripping was accomplished by an electro-magnetic device actuated by a thread which the horse broke as he walked, trotted or ran along the course prepared for him. Like modern movie producers, Muybridge built sets for staging his drama of motion.

With Stanford's horses "on location" in Sacramento and in their Palo Alto home, Muybridge photographed them as they went through their various gaits—a bewildering number of "methods of locomotion" to a generation less familiar with horses. There was the walk, "a method of progressive motion with a regular individual succession of limb movements . . . its execution is regulated by the law that the movement of the *superior* limb precedes the movement of its lateral *inferior* limb." During the walk the horse has always two, sometimes three feet on the ground at one time. Then there was the "amble," sometimes known as the "fox trot." In this "the support of the body devolves alternately upon a single foot and upon two feet; the single foot being alternately a hind foot and a fore foot, and the two feet being alternately laterals and diagonals. At no time is the body entirely unsupported."

The trot, the source of the controversy which started Muybridge's researches, is described as "a more or less rapid progressive motion in which the diagonal limbs act nearly simultaneously in being alternately lifted from and placed on the ground, and in which the body of the animal is entirely unsupported twice during each stride."

In the rack "two lateral feet with nearly synchronous action are placed upon and lifted from the ground alternately with the other laterals, the body of the animal being in the intervals entirely without support." It is declared "an ungraceful gait of the horse, and disagreeable to those who seek comfort in riding."

Then follow descriptions of a different set of motions, the canter, the gallop and the leap. It is in representing these rapid actions that artists had gone so wide of the mark, showing the horse with legs outstretched and completely off the ground, while the photographs showed that "the only phase in which he has been discovered without support is one when the legs are flexed under the body.

Having analyzed the motion of animals, Muybridge next devised an instrument which would combine the pictures into the illusion of reality. He discovered that this depended on an optical law "which in the construction of a zoopraxiscope requires that the number of illustrations must bear a certain relationship to the number of perforations through which they are viewed.

"The popular number of thirteen having been selected for the latter, the same number of figures illustrate actions without lateral progressive motion.

"When the number of illustrated phases is less than the number of perforations, the succesion of phases is in the direction of the motion, and the disc is necessarily revolved in a reverse direction.

"When the number of phases is greater than the number of perforations, the phases succeed each other in a direction contrary to that of the motion, and the disc is revolved in the direction of the motion. An increased or diminished number of figures will respectively result in an increased or diminished apparent speed of the object."

The Zoopraxiscope, like all the early forms of moving picture projectors, was absolutely limited in the number of pictures it could show, and consequently doomed its shadow actors to monotonous repetition of one series of acts. But movie audiences were not so sophisticated then as now. The press of the world rang with praise.

At a gala performance at the Royal Institution, attended by the Royal family and by Huxley, Gladstone, Tyndall and Tennyson, the *Illustrated London News* reported: "Mr. Muybridge exhibited a large number of photographs of horses galloping, leaping, etc. By the aid of an astonishing apparatus caled a Zoopraxiscope, which may be briefly described as a magic lantern run mad (with method in the madness), the animals walked, cantered, ambled, galloped and leaped over hurdles in a perfectly natural and lifelike manner."

And so the horse, though becoming more and more "a vain thing for safety," has played the leading part in at least two important programs of scientific research. The interest in variety of gaits, which seemed so important a half-century ago, has narrowed to an interest chiefly in speed today. The horse has been so far supplanted by the automobile as a means of "locomotion" that "horse transportation" trucks are no more incongruous than busses on our highways. The horses that ride in them are creatures of luxury with truly regal pedigrees, and a research institution becomes their college of heraldry as Science, the Monarch of Intellect, goes in for the Sport of Kings.

Science News-Letter, December 14, 1929

Staff of Science Service—Acting Director, Vernon Kellogg; Managing Editor, Watson Davis; Staff Writers, Frank Thone, James Stokley, Emily C. Davis, Jane Stafford, Marjorie Van de Water; Librarian, Minna Gill; Sales and Advertising Manager, Hallie Jenkins.

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Asteroids—*Cont'd*

of the solar system, although apparently simple, would not have been the true theory. Every new discovery shows the solar system to be more complex than we had supposed; and unless we prefer error (provided it has a show of simplicity) to truth, when it appears to our view complex, we shall value every new discovery in the solar system, because it promises to conduct us nearer to the true theory of the universe. Every new asteroid which is discovered is a new fact to be explained. The true philosopher, instead of regarding the rapidly increasing number of asteroids with indifference, will watch each new discovery with growing interest, in the hope that it may furnish the key to the true theory of the solar system.

Science News-Letter, December 14, 1929

FIRST GLANCES AT NEW BOOKS

PREHISTORIC ART OF THE ALASKAN ESKIMO—Henry B. Collins, Jr.—*Smithsonian Institution* (55c). The surprising downward trend of culture in the prehistoric Arctic has been traced very recently, chiefly through the discovery of three successive types of art work. Mr. Collins surveys briefly the discoveries that have been made and describes a number of the decorated objects dug out of frozen trash heaps in the past three years. There are twenty-four plates providing clear illustrations of the changes in this art from ancient to recent times.

Archæology
Science News-Letter, December 14, 1929

TALES OF THE NORTH AMERICAN INDIANS—Selected and annotated by Stith Thompson—*Harvard University Press* ($6). For the discriminating reader or student interested in typical examples of the native literature of America. The ninety-six stories chosen are from collections of field workers and represent the range of tribes of the United States and Alaska. The bibliography and notes at the end of the volume will be valuable to those who wish to probe further into the significance of the myths and other stories or to trace the motifs as they appear among various Indian groups.

Ethnology
Science News-Letter, December 14, 1929

MAGIC SPADES—R. V. D. Magoffin and Emily C. Davis—*Holt* ($5). The romance of archæology, forcefully and attractively presented by the president of the Archæological Institute of America and a member of the staff of Science Service. In the division of labor, the preparation of the first part of the book, dealing with the classical Old World, fell to Dr. Magoffin, and the second part, on Northern Europe and American prehistory, to Miss Davis. The result has been a very happy one, for the reader steps over the Atlantic Ocean in the middle of the book without the least sense of a jar, and finds his wanderings among the Aztecs and Moundbuilders as fascinating as his sojourn with the Pharaohs and the Caesars. *Magic Spades* will undoubtedly find wide use in college courses, and for Christmas presentation it is as good a book as can be found in a day's search.

Archæology
Science News-Letter, December 14, 1929

A VERY NAKED PEOPLE—Albert Londres—*Liveright* ($3). As vivid a book of Africa as has been written. The author's staccato style, his graphic language, his reporting of conversations and events "conjure" us into feeling that we are with him in French Africa. The account of native conditions in the colonies is said to have aroused in France some of the excitement which "Mother India" aroused in England.

Ethnology
Science News-Letter, December 14, 1929

OFFICIAL YEAR BOOK COMMONWEALTH OF AUSTRALIA—Charles H. Wichens—*Commonwealth Bureau of Census and Statistics.* The annual reports of the Australian Bureau of Census and Statistics are the best of their kind in the world and contain much of interest to American students of sociology, labor and politics.

Sociology
Science News-Letter, December 14, 1929

ORGANIC EVOLUTION—Richard Swann Lull—*Macmillan* ($4.50). The success of Prof. Lull's book has already been attested by the eight printings of the old edition; this revision, which inaugurates the ninth, will undoubtedly continue this enviable record. Inasmuch as perhaps a majority of writers on evolution have been interested in genetics or some other branch of "contemporary" biology, it is especially a matter for congratulation that we have here a book written by a highly qualified paleontologist.

Evolution
Science News-Letter, December 14, 1929

THE CHIEF OF THE HERD—Dhan Gopal Mukerji — Dutton ($2.50). Rudyard Kipling first made animal tales from India popular in the West. But now comes a generation of Indian writers who find an audience prepared for them, and have a more intimate knowledge of the best tales to tell. Mr. Mukerji has already scored several successes, and this story of the life of the sagacious leader of an elephant herd is a worthy addition to his list.

Nature
Science News-Letter, December 14, 1929

ADVANCED BIOLOGY — Frank M. Wheat and Elizabeth T. Fitzpatrick—*American Book Company* ($1.80). A textbook for high school classes in advanced biology.

Biology
Science News-Letter, December 14, 1929

IN THE ZOO—W. Reid Blair—*Scribner's* ($2.50). This book, by the director and general curator of the New York Zoological Park, will do much to heighten the already great interest shown by the American public in the citizens of their great zoological parks. Especially interesting are the accounts of events about the zoo that most of us never get to see: the capture and transportation of wild animals, their care and feeding, and especially what is done for them when they are sick or injured. The photographic illustrations are superb.

Zoology
Science News-Letter, December 14, 1929

WAR WHOOP AND TOMAHAWK—Ernest Harold Baynes—*Macmillan* ($1.75). War Whoop and Tomahawk were a pair of bison calves which the author trained as draft animals, just to show doubters it could be done and as an argument for the encouragement and better care of a dwindling American species. He has made even the record of kicks and bumps both absorbing and amusing.

Zoology
Science News-Letter, December 14, 1929

IMPORTED INSECT ENEMIES OF THE GIPSY MOTH AND THE BROWN-TAIL MOTH—A. F. Burgess and S. S. Crossman—*Government Printing Office* (50c). This publication, which is Technical Bulletin No. 86 of the U. S. Department of Agriculture, is of especial interest to every one interested in the biological control of insect pests.

Entomology
Science News-Letter, December 14, 1929

WHAT TO TELL THE PEOPLE ABOUT THE PUBLIC SCHOOLS—Belmont Mercer Farley—*Teachers College, Columbia University* ($1.75). An investigation of what topics of school news people like to read, and what sort of school news the newspapers actually present. The author follows this with practical suggestions for those who deal with school publicity and who may wish examples of facts and events that are of greatest interest.

Education
Science News-Letter, December 14, 1929

COMMERCE YEARBOOK, 1929. VOL. II: FOREIGN COUNTRIES—*U. S. Government Printing Office* ($1). Masses of valuable statistical information and numbers of maps, all the way from Argentina to the U. S. S. R.

Commerce
Science News-Letter, December 14, 1929

First Glances at New Books—*Continued*

THE PSYCHOLOGICAL REGISTER—Edited by Carl Murchison—*Clark University Press* ($6). A directory of about 1,300 living psychologists in America and other countries, showing in each professional biography the individual's training, positions held, editorships, honors, followed by a reference list of psychological articles and books published. The American section is more complete than those devoted to foreign countries, chiefly due to the greater difficulties of standardizing the foreign lists and obtaining data.

Psychology
Science News-Letter, December 14, 1929

TWENTY YEARS OF MENTAL HYGIENE, 1909-1929—*American Foundation for Mental Hygiene.* A stock-taking of the origin, purpose, accomplishments, and present status of the mental hygiene movement. The material thus brought together forms a useful reference book, for it includes the first mental hygiene publication ever issued, a classic report of a survey by the late Dr. T. W. Salmon, an article explaining how a child guidance clinic achieves results, a directory of state and local societies, and a list of publications of the National Committee for Mental Hygiene.

Mental Hygiene
Science News-Letter, December 14, 1929

PSYCHOPHYSIOLOGY, Volume I: Problems of Psychology and Perception—Leonard T. Troland—*Van Nostrand* ($4). Dr. Troland's point of view would preserve "what is valuable in behavioristic practice," meanwhile asserting the value of introspection as a psychological method. Thus, he aims to bring into harmony the two clashing factions of psychology and to establish a basis on which sound scientific progress may be made. This first volume in a series of four deals with psychology as a science of immediate experience, the physiological mechanism of the nervous system, and the main facts of perception.

Psychology
Science News-Letter, December 14, 1929

HOW TO TEACH SECONDARY CHEMISTRY AND ALLIED SCIENCES—Hattie D. F. HAUB—*Harr Wagner, San Francisco* ($7). A compact book of practical suggestions, by a teacher who has been behind the lecture-desk long enough to know the possibilities and difficulties of her craft.

Chemistry
Science News-Letter, December 14, 1929

THE DEVELOPMENT OF ASTRO-PHOTOGRAPHY AND THE GREAT TELESCOPES OF THE FUTURE—G. W. Ritchey—*Société Astronomique de France, 28 rue Serpente, Paris 6e.* (60 francs). For nearly a decade Prof. Ritchey has been working in a special laboratory at the Paris Observatory on methods of making large reflecting telescopes, surpassing in size any that have been made so far. Perhaps the chief problem is the huge mirror, but as he has to his credit more than a hundred telescope mirrors, including the world's largest, at the Mt. Wilson Observatory, he is entitled to speak with authority. In this beautiful brochure, with text in both English and French, he outlines his achievements including the cellular mirror, and plans for the future a chain of great observatories, of an entirely new type, advantageously placed in various parts of the world. The wonderfully executed half-tone illustrations show some of the instruments that he has been concerned with and some of the magnificent results that he has obtained with them. His project is vast, and a dream at present, but one hopes that it is a dream that will come true.

Astronomy
Science News-Letter, December 14, 1929

THIS AVIATION BUSINESS—Ernest W. Dichman—*Brentano's* ($3.50). To those who look upon aviation as an industry, to those who plan or hope to aid its development, this book written from the business, rather than the engineering, viewpoint will be helpful.

Aviation
Science News-Letter, December 14, 1929

THE NAVIGATION OF AIRCRAFT—Logan C. Ramsey—*Ronald* ($4.50). Navigation is even more important to aircraft than to the ships of the sea. The problems of the aviator in steering his course in a three-dimensional medium, not only are more intricate, but must be solved with greater speed and precision. This book will be useful to those who expect to wrestle with aerial navigation.

Aviation
Science News-Letter, December 14, 1929

AEROPLANE CONSTRUCTION AND OPERATION AND MAINTENANCE—John B. Rathbun—*Stanton* ($2.50). This aeronautical handbook, in its seventh edition, contains glossaries, general description, historical material and engineering data.

Aviation
Science News-Letter, December 14, 1929

APPLIED GEOPHYSICS—A. S. Eve and D. A. Keys—*Macmillan* ($4.50). In olden times men invoked magic in locating underground mineral deposits when they used the divining rod, or similar devices. Though the divining rod has long since ceased to have any scientific standing, the modern magic of science has replaced it with new and authentic divining rods. In this book two McGill University professors tell how such instruments as the torsion balance, the seismograph, and various electrical, radio and magnetic devices have superseded the hazel wand.

Mining—Geophysics
Science News-Letter, December 14, 1929

WHEN MAMMOTHS ROAMED THE FROZEN EARTH—Heinrich Schütz, trans. by Frank Barnes—*Jonathan Cape and Harrison Smith* ($2.50). A well-told tale of animal life in central Europe when the last of the Pleistocene ice was melting off. The author has a most happy ability to present the events of centuries, such as the development of an entire plant succession, in a single rapid dramatic paragraph. The English title is a little misleading, for the main thread of the story is carried by a single mammoth, the sole survivor of the once vast herd, roaming an earth no longer frozen, a lingering portent of the past, awing his fellow-beasts and at last glimpsed by invading Man to become a legend.

Paleontology
Science News-Letter, December 14, 1929

AN INTRODUCTION TO MECHANICS—J. W. Campbell—*Houghton, Mifflin* ($3.50). A college text that represents a welcome departure from the frequent practice of sugar-coating material for students by eliminating the mathematics. Prof. Campbell does not hesitate to introduce the calculus at an early stage, and though the student may have his troubles, he will at least know something about mechanics when he is through.

Mechanics
Science News-Letter, December 14, 1929

COLLEGE AND REFERENCE LIBRARY YEARBOOK—A Committee of the College and Reference Section of the American Library Association—*American Library Association* ($2.50). Since books perform an important function in education and research, this handbook on specialized libraries will perform a useful function in making such library activities more efficient.

Library Science
Science News-Letter, December 14, 1929